

**Relative Nesting Success of Neotropical Woodland
Migrants in Natural Riparian Woodlands and Farmstead
Woodlots in Southeastern SD**

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PROJECT TITLE: Relative Nesting Success of Neotropical Woodland Migrants in Natural Riparian Woodlands and Farmstead Woodlots in Southeastern South Dakota.

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The stated objectives of this project as provided in the contract were to:

1. Determine abundance and species richness for birds breeding in natural riparian woodlands and farmstead woodlots in southeastern South Dakota.
2. Determine relative nesting success for Neotropical and short-distance migrants in riparian woodlands and farmstead woodlots. In addition, we sought to locate and carefully monitor nests of any South Dakota Natural Heritage species that we may find in these habitats.
3. Undertake coarse-scale vegetative analyses around nest sites to identify vegetative characteristics potentially important to nest location and success in Neotropical short-distance migrants.

INTRODUCTION

Recent population declines have been documented for many species of Neotropical migrant birds breeding in North America (Robbins et al. 1989, Askins et al. 1990, DeGraaf and Rappole 1995), including several species breeding in South Dakota (Peterson 1995). These declines have been attributed to a number of factors that relate to conditions on breeding grounds (forest fragmentation and associated increases in nest predation and cowbird parasitism), wintering grounds (tropical deforestation), and along migratory routes (reductions in available stopover habitat) (Robbins et al. 1989, Terborgh 1989, Finch 1991, Moore et al. 1993). Forest fragmentation on the breeding grounds is one factor that has been implicated in population declines of Neotropical migrants, and avian density, species richness, and nesting success are generally reduced in forest fragments relative to larger sections of forest in eastern North America (Robbins et al. 1989, Askins et al. 1990). Reduced breeding success in fragmented parcels may be due to higher nest predation rates, as nest predation is higher at forest edges than in the interior (Wilcove 1985, Yahner and Scott 1988, Martin 1992), or to increased cowbird parasitism of nests, which is also more common at forest edges than in the interior (Brittingham and Temple 1983, Temple and Cary 1988, Robinson 1992, Robinson et al. 1995).

The foregoing comments apply principally to fragmented eastern deciduous forests, so whether these findings also apply to wooded habitats in the northern Great Plains is uncertain. Historically, woodland habitats within the northern Great Plains have been located almost exclusively along river corridors as riparian gallery forests (Van Bruggen 1996). These riparian woodlands provide breeding habitat for a number of species typical of eastern deciduous forests (Tallman et al. 2002). However, because of their linear nature and their limited extent, within the grassland/agricultural field-dominated northern Great Plains, these habitats have considerably more edge than unfragmented eastern deciduous forest. In addition, these riparian habitats have been considerably reduced and altered over the past century by conversion to agricultural fields and flooding under Missouri River reservoirs (Hesse 1996). For example, Hesse et al. (1988) found that riparian habitats along the middle Missouri River were reduced by 40-80% from 1892-1982. However, additional woodland habitats have appeared in the northern Great Plains over the past century in the form of farmstead woodlots and shelterbelts, where previously only grasslands

existed. These woodland habitats now account for a substantial fraction of the available woodland habitat in southeastern South Dakota (Castonguay 1982). Farmstead woodlots and shelterbelts occur as islands of woodland habitat in a landscape dominated by agricultural fields and pastures in this area (Martin 1980). Avian density and species richness generally increase with area within woodlots for breeding and migratory birds (Martin 1980, Yahner 1983, Bakker 2000). Bakker (2000) also found that natural woodlands in eastern South Dakota exhibited greater species richness of woodland obligate birds, but that planted woodlands attracted more woodland edge species. Whether breeding bird density and richness are lower in woodlots than in riparian corridor woodlands, which are generally of larger area even though they have been considerably fragmented, is unknown as no studies have directly addressed this question. During migration, avian density and richness were similar between riparian corridors and woodlots in southeastern South Dakota for Neotropical woodland migrants (Carlisle 1998, Dean 1999, Swanson et al. 2003).

Relative nesting success within riparian forests and woodlots in the northern Great Plains is also unstudied. Farmstead woodlots and shelterbelts potentially could substitute for lost or degraded riparian woodlands by providing nesting habitat for Neotropical migrants, but only if productivity in anthropogenic habitats is similar to that for riparian woodlands (Dobkin 1994). Some authors have suggested that farmstead woodlots or fragmented forest parcels might serve as ecological traps by attracting birds to forested habitat while offering only limited nesting success (Gates and Gysel 1978, Robinson 1992, Dobkin 1994). Studies of relative nesting success in woodlots and riparian habitats in the northern Great Plains are needed to determine if anthropogenic woodland habitats can substitute for reduced natural woodland habitats as productive nesting habitat for Neotropical migrants. Such information is necessary for source-sink analyses of populations and would be useful for management decisions regarding forest preservation and Neotropical migrant conservation. This study monitored abundance, species richness, and relative nesting success for Neotropical and short-distance migrant bird species nesting in both farmstead woodlots and riparian corridors in southeastern South Dakota to determine the relative importance of these habitats to successful nesting for these species.

METHODS

Study Sites

Riparian study sites for this study included four sites in the Missouri River corridor in Clay and Union counties and four sites in the Big Sioux River (and Brule Creek) corridor in Union and Lincoln counties. The Missouri River study sites were located in riparian habitats west, south, and southeast of Vermillion. These include Clay County Park (42°45'N, 97°W), Myron Grove River Access Area (42°46'N, 97°07'W), a Game Production Area south of the Vermillion Airport (42°45'N, 96°58'W) and a River Access Area southeast of Burbank (42°42'N, 96°48'W). The Big Sioux River study sites included three sites in riparian woodlands along the Big Sioux River. These sites are River Sioux Park, where Highway 50 crosses the river from Union County into Iowa (42°45'N, 96°37'W), Wilson Savanna Preserve, Lincoln County (43°09'N, 96°30'W) and Oak Ridge GPA, Lincoln Co. (43°10'N, 96°30'W). In addition, one site (Union Grove State Park) was included with both riparian and upland woodlands along Brule Creek (42° 55' N, 96° 46' W), a tributary of the Big Sioux River. Riparian habitats along the Missouri River consisted of deciduous forest dominated by cottonwood (*Populus deltoides*), boxelder (*Acer negundo*), American elm (*Ulmus americana*), mulberry (*Morus alba*), and dogwood (*Cornus* spp.), except for the Burbank site, which also contained some early successional habitat dominated by willows (*Salix* spp.) and dogwood (Swanson 1999). The Big Sioux River sites were dominated by boxelder, silver maple (*Acer saccharinum*), American elm, bur oak (*Quercus macrocarpa*), and cottonwood. The riparian forest at Union Grove State Park

consisted mainly of boxelder and American elm, while the upland forest was dominated by bur oak, with American elm and hackberry (*Celtis occidentalis*) also present. The Missouri River study sites have a generally west-east orientation, while the Big Sioux River and Brule Creek sites are oriented north to south.

We obtained permission to use thirteen different farmstead woodlots (15 survey points total) in Clay County as study sites. These included the same six woodlots as those studied by Swanson et al. (2003) for stopover biology of Neotropical woodland migrants, plus seven additional woodlots. These woodlots were scattered along an approximately 20-mile route and ranged from about 0.7-3.5 hectares in area. The architecture of the study woodlots was generally not linear and narrow (i.e., shelterbelts), but instead was roughly rectangular or arranged in an "L-shape." All woodlots were separated from each other by at least 1 km. The most common tree species in the six woodlots studied by Swanson et al. (2003) were elms, which comprised 54% of all trees counted. Other prominent woodlot tree species in that study included Mulberry (19.7%), Box Elder (8.7%), Hackberry (7.9%), and Green Ash (4.1%). A number of other tree species were also present, but they comprised less than 2% of the total.

Breeding Bird Abundance and Richness

For abundance and richness determination we used fixed-radius (25 m) point counts (Hutto et al. 1986). Roughly linear transects, 800-1000 m in length, were established at riparian study sites. Points were arranged along these transects and separated by at least 200 m to avoid double counting of birds. This provided 5-6 survey points at each riparian study site. At the Union Grove State Park site, two transects of three points each were established, one each in riparian and upland habitat types. Thus, Missouri and Big Sioux river (and tributary) corridors had 20-21 total survey points. Survey points were also established in the thirteen woodlots. Each woodlot had one point, except for the two largest (> 2.5 hectares), which had two points separated by more than 200 m. The 13 woodlots were divided into two transects, each with 7-8 points, for the point count surveys. Surveys were conducted four times during each of the three breeding seasons (2000-2002) and survey dates were 6-9 June, 27-30 June, 13-18 July, and 3-8 August. All counts were conducted between 0545 and 0930 CST and counts were not conducted on days with rain or high wind. Successive counts were separated by at least 10 days and the direction in which transects were conducted was reversed on successive counts to reduce possible temporal bias. This number of points and replicates has been shown to provide stable density estimates in habitats with heterogeneous vegetation (Morrison et al. 1981). All birds detected by sight or by sound were identified and counted and their distance from the point center was measured with a Ranging Model 620 rangefinder. Distances were recorded as inside or outside 25 m from the point center (Hutto et al. 1986, Bibby et al. 1992). Survey periods lasted 10 min per point. Birds detected while walking between points were counted and their distance from the nearest point recorded. Birds detected while flying overhead were counted only if they potentially used the habitat. Overall abundance was computed from detections inside 25 m to calculate densities (birds km⁻²) and from all detections (inside and outside 25 m) to calculate relative abundances (birds/point) (Swanson 1999).

Nest Searching

Nest searches were conducted at three riparian study sites (Clay County Park, Airport GPA and Union Grove State Park) and at four different woodlots during the breeding season of 2002. Nest searching began in earnest on 22 May, although a few nests were actually monitored from early May, and continued through July. These dates cover the bulk of the nesting season for Neotropical migrants in South Dakota (Peterson 1995, Tallman et al. 2002). Nests were checked every 3-4 d to monitor their activity and to determine success or failure. Nests were considered successful if they fledged at least one chick. If late nestlings were present on the previous nest check, but were absent on the final nest check, and evidence of fledging was present (e.g., excreta

on the edge of the nest, fledglings in the immediate nest vicinity), the nest was considered successful and the fledgling date was considered as the midpoint between the two dates (Manolis et al. 2000). If evidence of fledging was absent, we used the previous date of observation to determine exposure days. Following fledging or nest failure, vegetation around the nest was described. Vegetation data included the plant species in which the nest was located, nest height, nest location (e.g., fork, on branch, cavity), distance to edge, and vegetation density and diversity. The size of vegetation sampling plots differed depending on the vegetative cover category. For open woodlands, we counted the number and species with stems > 1 cm in diameter at their base within a 10-m^2 radius circle centered on the nest tree, for dense woodlands, we used a 10-m^2 rectangle centered on the nest plant, and for dense shrubby habitat, we used two strip transects arranged perpendicular to each other, each 0.6 m wide and 10 m long and centered on the nest shrub.

Data Analysis

Daily nest survival rates for all species pooled, for Neotropical and short-distance migrants, for nest height categories (≤ 5 m vs. > 5 m), and for individual species with sufficient nest numbers were calculated by the Mayfield method (Mayfield 1961, 1975). We used Z-tests (Johnson 1979) to statistically compare daily nest survival rates between natural and anthropogenic habitats and between other nesting categories. These tests were run for the overall Neotropical and short-distance migrant populations (all species pooled, categories based on DeGraaf and Rappole 1995), for general nest habitat categories (shrub vs. open woodland vs. dense woodland), and for individual species if they have sufficient numbers of nests located ($n \geq 15$, Willson and Gende 2000).

Overall avian abundance (i.e., numbers of observations) in corridors and woodlots was compared by Chi-square analysis after correction for equal effort. Comparisons of species richness among different sites and different studies are confounded by differences in sampling effort and numbers of observations because more species would be expected to be detected with an increased number of observations. The technique of rarefaction has been developed to compare richness at sites with different sample sizes and works by calculating an expected number of species ($E[S_n]$) for a given sample size from each site (James and Rathbun 1981). We calculated rarefaction curves for both riparian woodland and farmstead woodlot survey data and compared these curves to determine if species richness differed between the two habitats.

RESULTS AND DISCUSSION

Avian Abundance and Species Richness

Overall densities for all birds were $3,301$ birds km^{-2} at Missouri River riparian sites, $2,449$ birds km^{-2} at Big Sioux River (and tributaries) riparian sites, and $3,277$ birds km^{-2} at woodlots. Overall relative abundances for all birds were 15.0 birds/point at Missouri River riparian sites, 13.5 birds/point at Big Sioux River (and tributaries) riparian sites, and 13.5 birds/point at woodlots. The overall numbers of birds observed on point counts was significantly higher at Missouri River sites than at Big Sioux River sites ($\chi^2 = 4.25$, $P = 0.04$) and at woodlot sites ($\chi^2 = 11.51$, $P < 0.001$). Overall numbers of observations did not differ significantly between Big Sioux River and woodlot study sites. The densities and relative abundances for individual species in Missouri and Big Sioux river corridors and in woodlots are provided in Appendix 1. House Wrens (*Troglodytes aedon*) were the most abundant species in all habitat types, but their abundance in woodlots was significantly ($P < 0.05$) higher than in corridors. Forest-edge species, such as Red-headed Woodpecker (*Melanerpes erythrocephalus*), American Robin (*Turdus migratorius*), Chipping Sparrow (*Spizella passerina*), Song Sparrow (*Melospiza melodia*), and Red-winged Blackbird (*Agelaius phoeniceus*), as well as House Sparrows (*Passer domesticus*), had significantly ($P < 0.05$) higher abundances in woodlots than in corridors. Forest interior species, such as Red-bellied Woodpecker (*Melanerpes carolinus*),

Eastern Wood-Pewee (*Contopus virens*), Great Crested Flycatcher (*Myiarchus crinitus*), Red-eyed Vireo (*Vireo olivaceus*), White-breasted Nuthatch (*Sitta carolinensis*), Wood Thrush (*Hylocichla mustelina*), Gray Catbird (*Dumetella carolinensis*), Eastern Towhee (*Pipilo erythrophthalmus*) and Rose-breasted Grosbeak (*Pheucticus ludovicianus*) had significantly ($P < 0.05$) higher abundances in corridors than in woodlots. Other species with significantly ($P < 0.05$) higher abundances in corridors than in woodlots included Cedar Waxwing (*Bombycilla cedrorum*), American Redstart (*Setophaga ruticilla*), and American Goldfinch (*Carduelis tristis*).

Overall species richness (number of species), excluding migratory species that do not breed in these habitats, was 46 at Missouri River riparian sites, 52 at Big Sioux River riparian sites and 40 at woodlots. Rarefaction curves for these habitats are provided in Figure 1. Rarefaction analyses indicated that species richness in the Big Sioux River corridor was higher than at other study areas. Species richness in the Missouri River corridor was greater than that in woodlots. Finally, the percentages of these breeding species made up of Neotropical migrants (here defined as species in which most of the population winters south of the U.S. border) were 47.8% at Missouri River sites, 46.2% at Big Sioux River sites, and 37.5% at woodlots. These data suggest that abundances of birds were generally similar among sites, although Missouri River sites had the highest overall abundance, but that species richness and the percentage of species made up of Neotropical migrants was lower in woodlots than in riparian areas.

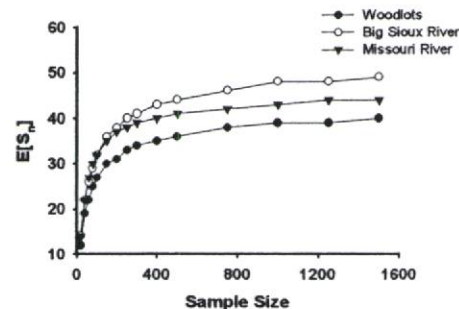


Figure 1. Rarefaction curves from point count data for woodlots and river corridor woodland sites. $E[S_n]$ is the expected number of species observed as a function of sample size.

Avian Nesting Success

We conducted nest searching in corridors and woodlots in the nesting seasons during 2000-2002, and include data for all three years here to increase the sample size for individual-species Mayfield comparisons. We found and monitored a total of 47 nests in 2000, 372 nests in 2001, and 237 nests in 2002 at all study sites, including totals of 333 at riparian sites and 323 at woodlots. The breakdown of nests per species is provided in Table 1. Raw data for 2002 nests, including exposure days, nest fate (result), nest height, and nest tree species are included for all habitats in Appendices 2 and 3. Not surprisingly, nests from a greater number of bird species were found in corridors than in woodlots. Nests of 20 species were found in the Missouri River corridor, 17 species in the Big Sioux River corridor (25 species for both corridors combined), and 15 species in woodlots. Nests of American Robins were numerically dominant in woodlots, making up 151 of the total of 323 nests found (46.7%). Nests of seven species made up 72.1% of all corridor nests found, and 28-40 nests were found for each of these species (Table 1). These seven species were Eastern Kingbird (*Tyrannus tyrannus*), American Robin (*Turdus migratorius*), Gray Catbird (*Dumetella carolinensis*), Brown Thrasher (*Toxostoma rufum*), Yellow Warbler (*Dendroica petechia*), Rose-breasted Grosbeak (*Pheucticus ludovicianus*) and Baltimore Oriole (*Icterus galbula*).

Mayfield analyses of daily nest survival (\pm SE) for nests of all species pooled in 2002 gave values of 0.973 ± 0.004 in woodlots and 0.970 ± 0.004 in corridors. These values did not differ significantly ($P = 0.65$). In addition, these values did not differ significantly from 2001 values for all species pooled ($P > 0.5$ for both woodlots and corridors), which were 0.970 ± 0.003 in woodlots and 0.967 ± 0.003 in corridors. We found 15 or more nests in both corridors and woodlots for five species (Table 1), so we were able to compare nest survival between corridors and woodlots for these

species. None of these five species showed significant differences in daily nest survival rates between corridors and woodlots. P-values for these comparisons were 0.61 for Eastern Kingbirds (*Tyrannus tyrannus*), 0.40 for Gray Catbirds, 0.52 for American Robins, 0.13 for Baltimore Orioles (*Icterus galbula*) and 0.27 for Orchard Orioles (*Icterus spurius*). Daily nest survival rates for these species were: Eastern Kingbird (0.990 ± 0.004 in woodlots, 0.987 ± 0.005 in corridors); Gray Catbird (0.955 ± 0.011 in woodlots, 0.966 ± 0.008 in corridors); American Robin (0.964 ± 0.004 in woodlots, 0.957 ± 0.011 in corridors); Baltimore Oriole (0.994 ± 0.003 in woodlots, 0.985 ± 0.005 in corridors); and Orchard Orioles (0.989 ± 0.005 in woodlots, 0.977 ± 0.009 in corridors).

Daily nest survival values for nests ≤ 5 m in height were 0.9646 ($n = 58$) in woodlots and 0.9628 ($n = 53$) in corridors. For nests > 5 m in height, daily nest survival values were 0.9780 ($n = 64$) in woodlots and 0.9763 ($n = 58$) in corridors. Nesting success of nests in the two height categories (≤ 5 m and > 5 m) did not differ between corridors and woodlots. Daily nest survival of nests (corridor and woodlot nests pooled) located above 5 m in height (0.9773, $n = 122$) was significantly higher ($P = 0.017$) than nests below 5 m (0.9637, $n = 111$). These results are similar to those for nests in 2000/2001. For nests in 2000/2001, distance from the nest to the edge of the woodland or shrub habitat had no significant influence on daily nest survival. For 2002 data, corridor nests showed no significant relationship between nest survival and distance from the habitat edge, as daily survival of nests in the ≤ 5 m (0.9643, $n = 49$), 5-20 m (0.9594, $n = 34$), and > 20 m (0.9784, $n = 28$) categories were statistically indistinguishable. However, daily survival in woodlot nests that were > 20 m from the habitat edge (0.9331, $n = 14$) was significantly lower ($P < 0.05$) than nests ≤ 5 m from the habitat edge (0.9729, $n = 62$) or nests 5-20 m from the habitat edge (0.9800, $n = 46$). This is contrary to expectations, and may be an artifact of small sample size in the > 20 m category, as approximately 20 nests are required for reliable Mayfield estimates of nest success (Hensler and Nichols 1981). Also of interest, daily survival of nests in woodlots in the 5-20 m category was significantly greater ($P = 0.045$) than that of nests in corridors in that category. An explanation for this difference is not readily apparent, especially since corridor nests in the > 20 m category had a significantly higher ($P = 0.029$) rate of daily nest survival than woodlot nests in the > 20 m category. Once again, however, this latter result is tenuous because of the low sample size in the > 20 m category in woodlot habitats. Pooled (corridor and woodlot nests combined) daily survival values did not differ significantly among the different distance to edge categories, which is similar to the 2000/2001 data.

For habitat categories, daily nest survival in open or closed canopy woodlands did not vary significantly between woodlots and corridors, so data were pooled. Only five shrub habitat nests were found in both habitats in 2002, so nesting success in this habitat category could not be reliably calculated. Daily nest survival did not differ between open (0.9699, $n = 58$) and closed canopy (0.9747, $n = 97$) woodlands in 2002. This result is identical to the results for these woodland types in 2000/2001. Finally, daily nest survival for Neotropical migrants was significantly greater than for short-distance migrants in both habitats ($P = 0.002$ and 0.011 for woodlots and corridors, respectively). For both habitats pooled, daily nest survival of Neotropical migrants (0.9813, $n = 113$) was also significantly greater ($P < 0.001$) than that for short-distance migrants (0.9595, $n = 120$). This is similar to the results from 2000/2001. Contrary to 2000/2001, however, daily nest survival of Neotropical migrants did not differ significantly between woodlots and corridors; nest survival was higher in woodlots in 2000/2001. Daily nest survival also did not differ significantly between the two habitats for short-distance migrants.

These data suggest, in general, that nesting success is similar in woodlots and riparian areas. Moreover, most species appear to be as successful in woodlots as they are in corridors. Indeed, all species for which we had sufficient nests in each habitat to calculate reliable nest success rates showed no differences in daily nest survival between habitats. Furthermore, Neotropical migrants were as successful in woodlots as they were in riparian corridor woodlands, even though fewer Neotropical migrant species occurred in woodlots than in riparian corridor woodlands.

CONCLUSIONS

Avian abundance was generally similar between corridors and woodlots, but species richness was lower in woodlots than in corridors, particularly lower than in the Big Sioux River corridor, which showed the highest species richness of all study areas. Not surprisingly, much of the reduced richness in woodlots was due to the absence of species associated with woodland interiors or requiring larger woodland tracts for nesting. These species included Great Crested Flycatcher, Yellow-throated (*Vireo flavifrons*) and Red-eyed (*V. olivaceus*) vireos, American Redstart, Scarlet Tanager (*Piranga olivacea*), and Eastern Towhee. Other species with similar habitat or nesting requirements that had much higher abundances in corridors than in woodlots were Eastern Wood-Pewee, Wood Thrush, and Rose-breasted Grosbeak (*Pheucticus ludovicianus*). The only species monitored by the South Dakota Natural Heritage program (Dowd Stukel and Backlund 1997) that was detected in woodlots was the Wood Thrush, and it occurred in woodlots only at very low densities (Appendix 4). South Dakota Natural Heritage species detected in corridors included Ruby-throated Hummingbird (*Archilochus colubris*), Yellow-throated Vireo, Blue-gray Gnatcatcher (*Poliophtila caerulea*, Big Sioux River only), Wood Thrush, and Scarlet Tanager.

In addition, Neotropical migrants comprised a greater proportion of the breeding species richness in river corridor woodlands (46-48%) than in woodlots (37.5%). The percentage of Neotropical migrants in corridor woodlands is similar to avian communities documented for other natural woodland habitats in the northern Midwest or northern Great Plains, which range from 45-53% Neotropical migrants (Faanes 1984, Terborgh 1989, Liknes et al. 1994). These data suggest that river corridor woodlands and woodlots support similar overall avian abundances, but that the breeding bird community in woodlots has fewer species than that in corridors. This is particularly true for Neotropical migrant species. These data are consistent with those of other studies in the northern Midwest that documented a negative relationship between species richness or diversity and woodland area (Martin 1980, Yahner 1983, Bakker 2000).

Overall nesting success was similar between woodlots and corridors. Daily nest survival rates for general habitat categories (shrubs, open woodland, closed canopy woodland), nest height categories, distance to edge of vegetation, and individual species were also similar between woodlots and corridors. For Neotropical migrants, daily nest survival rates were actually slightly, but significantly, higher in woodlots than in riparian corridors. The general similarity in nesting success between corridors and woodlots and the better performance of Neotropical migrants in woodlots than in corridors was contrary to our initial expectations, which were that the larger areas and more contiguous nature of the river corridor woodlands would reduce predation and parasitism rates and elevate nesting success relative to woodlots. Perhaps this departure from our initial expectation is due to the still relatively small woodland area of riparian corridors (compared to eastern deciduous forests) and the often narrow and linear nature of these corridor woodlands. These data suggest that woodlots provide acceptable nesting habitat for a variety of species, including many Neotropical migrants, despite the overall species richness being lower than in natural riparian woodlands. Thus, woodlots appear to substitute as nesting habitat, at least partially, for the markedly reduced extent of natural riparian corridor woodlands in this area.

Management Implications

The data in this study indicate that woodlots can provide adequate nesting habitat for a variety of avian species. Species showing regional or range-wide population declines that nested in woodlots were Brown Thrasher (*Toxostoma rufum*), Common Yellowthroat (*Geothlypis trichas*), Baltimore and Orchard (*Icterus spurius*) orioles, Rose-breasted Grosbeak, and Indigo Bunting (*Passerina cyanea*) (DeGraaf and Rappole 1995, Peterson 1995). Even the small woodlots in this study (0.7-3.5 hectares) appear to provide adequate nesting habitat for these and

other species, so conservation of these habitats should benefit a number of birds. However, as Bakker (2000) noted, when grasslands were associated with nearby woodlands or shelterbelts, wooded habitats had a negative impact on the occurrence of grassland nesting birds. Thus, when considering the best procedures for conserving avian habitats, careful attention must be paid to the general habitat structure of woodlands and surrounding areas and to which birds represent the foremost conservation priorities. In addition, preservation of large natural riparian and upland woodlands is also important, because these habitats attract a wider variety of woodland nesting species than woodlots, including a higher percentage of Neotropical migrants and South Dakota Natural Heritage species.

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Table 1. Numbers of nests found in corridors and woodlots for individual open-cup nesting species. These totals include nests found during the nesting seasons of 2000 (47), 2001 (372) and 2002 (237).

Species	Corridor Nests	Woodlot Nests
Yellow-billed Cuckoo	1	2
Eastern Wood-Pewee	10	--
Eastern Phoebe	4	--
Eastern Kingbird	28	27
Bell's Vireo	7	--
Warbling Vireo	7	1
Red-eyed Vireo	1	--
Wood Thrush	7	--
American Robin	32	151
Gray Catbird	35	29
Brown Thrasher	32	9
Cedar Waxwing	3	6
Yellow Warbler	38	--
American Redstart	8	--
Common Yellowthroat	1	1
Eastern Towhee	5	--
Chipping Sparrow	5	15
Field Sparrow	6	--
Northern Cardinal	2	2
Rose-breasted Grosbeak	40	8
Blue Grosbeak	1	--
Indigo Bunting	1	--
Red-winged Blackbird	--	2
Common Grackle	9	20
Orchard Oriole	15	25
Baltimore Oriole	35	25
TOTALS	333	323

Appendix 1 - Point count data for all species detected (2000-2002) for corridors and woodlots. Data include Total Observations, Density (birds km⁻²) and Relative Abundance (birds/point). Species codes are the 4-letter BBL codes.

Big Sioux River Corridor				Missouri River Corridor				Woodlots			
Species	Total Obs	DENSITY	RA	Species	Total Obs	DENSITY	RA	Species	Total Obs	DENSITY	RA
ALFL	4	2.40	0.02	ALFL	6	7.64	0.03	ALFL	3	6.79	0.02
AMCR	65	0.00	0.31	AMCR	88	12.74	0.44	AMCR	32	13.58	0.21
AMGO	112	98.52	0.53	AMGO	113	129.90	0.57	AMGO	40	64.53	0.27
AMRE	71	112.94	0.33	AMRE	37	58.58	0.19	AMRO	235	468.67	1.57
AMRO	85	88.91	0.40	AMRO	41	56.04	0.21	BAOR	85	159.62	0.57
BAOR	52	50.46	0.25	BAEA	2	2.55	0.01	BBCU	5	6.79	0.03
BBCU	10	0.00	0.05	BAOR	127	175.75	0.64	BCCH	64	88.30	0.43
BCCH	151	168.21	0.71	BBCU	11	5.09	0.06	BHCO	37	47.55	0.25
BEKI	2	4.81	0.01	BCCH	95	129.90	0.48	BLGR	1	0.00	0.01
BGGN	12	24.03	0.06	BEVI	34	56.04	0.17	BLJA	111	159.62	0.74
BHCO	44	26.43	0.21	BHCO	67	71.32	0.34	BRNS	1	0.00	0.01
BLJA	192	122.55	0.91	BLJA	137	86.60	0.69	BRTH	29	64.53	0.19
BRNS	3	0.00	0.01	BRTH	27	43.30	0.14	CEDW	15	20.38	0.10
BRTH	22	16.82	0.10	CEDW	52	91.70	0.26	CHSP	20	40.75	0.13
CEDW	48	60.07	0.23	CHSW	1	0.00	0.01	COGR	88	149.43	0.59
CHSP	6	4.81	0.03	COGR	62	101.88	0.31	COYE	52	27.17	0.35
COGR	9	9.61	0.04	COYE	22	5.09	0.11	DICK	1	0.00	0.01
COHA	4	7.21	0.02	DOWO	46	40.75	0.23	DOWO	36	78.11	0.24
COYE	66	31.24	0.31	EABL	6	2.55	0.03	EAKI	106	176.60	0.71
DOWO	65	52.86	0.31	EAKI	162	147.73	0.81	EAWP	5	6.79	0.03
EAKI	26	16.82	0.12	EATO	61	73.87	0.31	EUST	50	64.53	0.33
EAPH	5	2.40	0.02	EAWP	143	127.36	0.72	FISP	12	3.40	0.08
EATO	128	98.52	0.60	FISP	58	43.30	0.29	GRCA	51	105.28	0.34
EAWP	98	45.66	0.46	GCFL	8	0.00	0.04	HAWO	2	3.40	0.01
EUST	10	7.21	0.05	GRCA	13	10.19	0.07	HOSP	71	98.49	0.47
FISP	90	38.45	0.42	HAWO	115	224.15	0.58	HOWR	354	777.72	2.36
GCFL	15	7.21	0.07	HOWR	9	10.19	0.05	INBU	33	33.96	0.22
GHOW	1	2.40	0.00	INBU	305	427.92	1.53	LASP	1	0.00	0.01
GRCA	145	216.27	0.68	LASP	46	40.75	0.23	LEFL	1	0.00	0.01
HAWO	12	7.21	0.06	LEFL	2	2.55	0.01	MODO	115	125.66	0.77
HOWR	363	458.96	1.71	MODO	5	12.74	0.03	NOCA	6	3.40	0.04
INBU	70	50.46	0.33	NOCA	162	76.41	0.81	NOFL	49	71.32	0.33
KEWA	1	0.00	0.00	NOFL	63	53.49	0.32	OROR	19	16.98	0.13
LEFL	2	0.00	0.01	OROR	52	28.02	0.26	RBGR	45	81.51	0.30
MODO	114	28.84	0.54	OVEN	47	81.51	0.24	RBWO	8	16.98	0.05
NOBO	2	0.00	0.01	PRWA	2	2.55	0.01	RHWO	105	169.81	0.70
NOCA	91	48.06	0.43	RBGR	1	2.55	0.01	RNPH	9	0.00	0.06
NOFL	22	12.01	0.10	RBWO	102	137.54	0.51	RTHA	1	0.00	0.01
OROR	1	0.00	0.00	REVI	33	25.47	0.17	RWBL	23	16.98	0.15
OSFL	1	0.00	0.00	RHWO	47	66.23	0.24	SOSP	50	27.17	0.33
OVEN	34	26.43	0.16	RNPH	88	73.87	0.44	TEWA	1	3.40	0.01
OVEN	1	2.40	0.00	RTHU	3	0.00	0.02	VESP	4	0.00	0.03
RBGR	130	158.59	0.61	RWBL	1	2.55	0.01	WAVI	14	33.96	0.09
RBWO	38	9.61	0.18	SCTA	2	2.55	0.01	WBNU	9	10.19	0.06
REVI	23	28.84	0.11	SOSP	1	0.00	0.01	WIFL	1	3.40	0.01
RHWO	25	12.01	0.12	TEWA	10	10.19	0.05	WOTH	1	0.00	0.01
RNPH	5	0.00	0.02	TRFL	3	2.55	0.02	YBCU	10	16.98	0.07
RTHA	2	0.00	0.01	TUVU	3	2.55	0.02	YWAR	10	13.58	0.07
RTHU	3	7.21	0.01	UNWO	3	0.00	0.02	Totals	2021	3277.30	13.47
RWBL	1	0.00	0.00	WAVI	3	0.00	0.02				
SCTA	11	12.01	0.05	WBNU	170	208.86	0.85				
SOSP	15	12.01	0.07	WIFL	67	58.58	0.34				
TRFL	1	2.40	0.00	WOTH	4	2.55	0.02				
TUVU	3	0.00	0.01	YBCU	80	25.47	0.40				
UNWO	2	0.00	0.01	YTVI	41	28.02	0.21				
WAVI	35	33.64	0.17	YWAR	7	10.19	0.04				
WBNU	107	79.30	0.50	Totals	107	201.22	0.54				
WHIP	1	2.40	0.00		3001	3301.07	15.01				
WITU	36	9.61	0.17								
WODU	5	0.00	0.02								
WOTH	71	19.22	0.33								
YBCU	25	7.21	0.12								
YBSA	3	0.00	0.01								
YTVI	1	0.00	0.00								
YWAR	69	103.33	0.33								
Totals	2867	2448.60	13.52								

Appendix 2 - 2002 Corridor Raw Nest Data. Columns are the specific study site, bird species, exposure days for the nest, nest result (failed, fledged, or uncertain?), nest number, nest height, distance to habitat edge, vegetation category (C - closed canopy, O - open woodland, S - shrub), and the tree species in which the nest was found.								
Site	Species	Exposure	Result	Nest #	Height (ft)	Edge (m)	Veg Cat	Tree
Airport	AMRO	10	fa	AMRO1A	18	15	C	elm
Airport	AMRO	12	fa	2A	60	10	C	cottonwd
Airport	AMRO	3	fa	4A	50	4	C	elm
Union	AMRO	14	fa	AMRO1U	3.5	1	O	juniper
Union	AMRO	1.5	fa	2U	60	15	C	cottonwd
Clay	AMRO	1.5	fa	AMRO1C	6.5	5.5	C	dogwood
Clay	AMRO	3	fa	2C	50	75	C/O	cottonwd
Clay	AMRO	1.5	fa	6C	70	75	C/O	cottonwd
Clay	AMRO	6.5	fa	10C	20	75	C/O	cottonwd
Union	AMRO	13.5	fa?	4U	30	9	C	cottonwd
Clay	AMRO	1.5	fa?	5C	30	75	C/O	cottonwd
Clay	AMRO	6	fa?	7C	90	75	C/O	cottonwd
Union	AMRO	31	fl	3U	5	2	O	juniper
Clay	AMRO	20	fl	3C	7	75	C/O	juniper
Clay	AMRO	5.5	fl	4C	5	2	O	juniper
Clay	AMRO	17	fl	9C	55	2	O	cottonwd
Airport	AMRO	26	fl?	3A	40	5	C	elm
Clay	AMRO	19	fl?	8C	35	3	O	cottonwd
Airport	BAOR	4	fa	1A	60	7	O	cottonwd
Airport	BAOR	3	fa?	3A	28	15	C	cottonwd
Airport	BAOR	10	fa?	4A	25	20	O	cottonwd
Clay	BAOR	18	fa?	BAOR1C	30	10	C	cottonwd
Clay	BAOR	6.5	fa?	3C	33	10	C	cottonwd
Union	BAOR	10	fl	2U	75	7	O	cottonwd
Clay	BAOR	3	fl	6C	25	15	C	cottonwd
Airport	BAOR	28	fl?	BAOR2A	90	10	C	cottonwd
Airport	BAOR	5	fl?	5A	30	20	C	elm
Airport	BAOR	8	fl?	6A	60	40	O	cottonwd
Union	BAOR	11	fl?	BAOR1U	40	10	O	elm
Clay	BAOR	32	fl?	2C	35	30	C	cottonwd
Clay	BAOR	22	fl?	4C	80	1	C	cottonwd
Clay	BAOR	19	fl?	5C	28	20	C	cottonwd
Clay	BAOR	8	fl?	7C	40	15	C	cottonwd
Union	BRTH	6	fa	BRTH1U	7	10	S	plum
Union	BRTH	6	fa	2U	4	1	O	juniper
Clay	BRTH	6	fa	BRTH1C	3.5	75	C	dogwood
Clay	BRTH	1.5	fa	3C	0	1	O	post
Clay	BRTH	13	fa	5C	5	5	C	dogwood
Clay	BRTH	23.5	fa	2C	5.5	2	C	rusolive
Clay	BRTH	21	fl	4C	0	4	C	dogwood
Clay	BRTH	20	fl	6C	7	40	C	chokechry
Airport	BRTH	20.5	fl?	BRTH1A	6	40	O	cottonwd
Airport	CHSP	1.5	fa	CHSP1A	0.5	0	O	shrub
Clay	CHSP	1.5	fa	CHSP1C	2	1	C/O	juniper
Clay	CHSP	13	fl	2C	6	1.5	C/O	juniper
Clay	COGR	15	fa	6C	7	2	C	dogwood

Clay	COGR	25	fl	5C	10	4	C	prickash
Clay	COGR	7	fl?	COGR1C	20	2	O	rusolive
Clay	COGR	21	fl?	2C	30	4	O	ash
Clay	COGR	26	fl?	3C	40	14	O	cottonwd
Clay	COGR	25	fl?	4C	20	2	O	rusolive
Clay	COGR	22	fl?	7C	25	2	O	rusolive
Union	EAKI	41.5	fa	EAKI1U	10	1	O	juniper
Clay	EAKI	20	fa	4C	18	5	C	mulberry
Clay	EAKI	10	fa	5C	70	5	C	cottonwd
Clay	EAKI	17	fa?	EAKI1C	50	10	C	cottonwd
Airport	EAKI	20.5	fl	EAKI2A	50	4	O	cottonwd
Airport	EAKI	16.5	fl	3A	70	4	C	cottonwd
Airport	EAKI	12	fl	5A	35	3	O	cottonwd
Union	EAKI	10	fl	2U	15	0.5	O	elm
Clay	EAKI	39.5	fl	2C	55	10	C	cottonwd
Clay	EAKI	6	fl	6C	70	75	C	cottonwd
Airport	EAKI	8	fl?	4A	100	30	C	cottonwd
Union	EAPH	1	fa	2U	5	1	O	bridge
Union	EAPH	18	fl	EAPU1U	5	1	O	bridge
Clay	EATO	6	fa	EATO1C	0	0	O	juniper
Clay	EATO	20	fl	2C	0	30	C	dogwood
Clay	EATO	12	fl?	3C	0	0	O	herb
Union	EAWP	36.5	fl	2U	20	25	C	elm
Clay	EAWP	27.5	fl	EAWP1C	40	75	C	cottonwd
Clay	EAWP	6.5	fl	2C	60	75	C	cottonwd
Clay	EAWP	6	fl	3C	50	75	C	cottonwd
Union	EAWP	36	fl?	EAWP1U	30	2	C	boxelder
Union	FISP	1.5	fa	FISP1U	0	1	S	plum
Union	FISP	10.5	fa	2U	0	0	O	grass
Union	FISP	13.5	fa	3U	2	0	O	plum
Union	GRCA	9	fa	GRCA1U	2.5	5	S	plum
Union	GRCA	23.5	fl	2U	10	25	C	elm
Clay	GRCA	20	fl	GRCA1C	4	1	C/O	juniper
Clay	GRCA	27.5	fl	2C	3	20	C	dogwood
Clay	GRCA	16.5	fl	3C	3	4	C	dogwood
Airport	NOCA	3	fa	NOCA1A	3	3	S	juniper
Union	NOCA	25.5	fl	NOCA1U	3	4	S	plum
Clay	OROR	3	fa	OROR1C	50	15	C	cottonwd
Clay	OROR	10	fa	6C	12	30	C	dogwood
Clay	OROR	12	fa?	3C	25	20	C	elm
Clay	OROR	29	fl	2C	30	4	O	cottonwd
Clay	OROR	31	fl	4C	12	12	C	boxelder
Clay	OROR	20	fl	5C	15	25	O	snag/grape
Airport	OROR	22	fl?	OROR1A	50	20	O	cottonwd
Union	OROR	32	fl?	OROR1U	30	6	C	elm
Union	RBGR	6	fa	RBGR3U	8	7	O	boxelder
Union	RBGR	1.5	fa	4U	12	2	O	elm
Union	RBGR	1.5	fa	7U	6	2	O	shrub
Clay	RBGR	1.5	fa	RBGR1Ca	5	7	O	juniper
Clay	RBGR	13	fa	1Cb	5	7	O	juniper
Clay	RBGR	6.5	fa	5C	15	20	C	elm

Union	RBGR	17	fl	8U	20	35	C	elm
Union	RBGR	27	fl	5U	6	3	C	elm
Clay	RBGR	25	fl	3C	5	4	C	dogwood
Airport	RBGR	19	fl?	RBGR2A	30	50	C	elm
Union	RBGR	25	fl?	1U	8	10	C	boxelder
Union	RBGR	30	fl?	6U	25	30	C	elm
Clay	RBGR	20	fl?	2C	12	75	C	elm
Clay	RBGR	19	fl?	4C	12	15	C	elm
Clay	WAVI	6	fa	WAVI1C	45	75	C	cottonwd
Clay	WAVI	32	fl?	2C	70	75	C/O	cottonwd
Airport	WOTH	3	fa	WOTH1A	3.5	25	C	hackberry
Union	YBCU	14	fl?	YBCU1U	25	3	O	ash
Clay	YWAR	17	fa	2C	10	20	C	dogwood
Clay	YWAR	22	fl	YWAR1C	8	1	C	dogwood
		1640.5						

Appendix 3 - 2002 Woodlot Raw Nest Data. Columns are the specific study site, bird species, exposure days for the nest, nest result (failed, fledged, or uncertain?), nest number, nest height, distance to habitat edge, vegetation category (C - closed canopy, O - open woodland, S - shrub), and the tree species in which the nest was found.								
Site	Species	Exposure	Result	Nest #	Height (ft)	Edge (m)	Veg Cat	Tree
L-shape	AMRO	10	fa	AMRO1L	8	2	C	mulberry
Renner	AMRO	13.5	fa	AMRO1R	20	15	C	ash
Renner	AMRO	3	fa	AMRO2R	4	0	O	building
Renner	AMRO	10	fa	AMRO3R	30	3	O	elm
Beard	AMRO	12.5	fa	AMRO7B	12	3	O	pine
Beard	AMRO	6	fa	AMRO8B	15	15	O	fruit
Beard	AMRO	6.5	fa	AMRO11B	35	30	O	pine
Beard	AMRO	3	fa	AMRO13B	12	35	O	pine
Beard	AMRO	3	fa	AMRO14B	20	20	O	pine
Beard	AMRO	6.5	fa	AMRO17B	20	20	O	snag
Beard	AMRO	6	fa	AMRO18B	25	35	O	elm
Beard	AMRO	9.5	fa	AMRO19B	20	20	O	ash
Beard	AMRO	13.5	fa	AMRO20B	10	80	O	ash
Beard	AMRO	6.5	fa	AMRO22B	15	30	O	ash
Beard	AMRO	19.5	fa	AMRO27B	20	5	O	ash
Swanson	AMRO	25	fa	AMRO2S	22	8	O	mulberry
Swanson	AMRO	12	fa	5S	32	3	C	elm
Swanson	AMRO	12	fa	6S	18	5	O	elm
Swanson	AMRO	1.5	fa	8S	18	3	O	mulberry
Swanson	AMRO	1.5	fa	10S	30	5	C	elm
Swanson	AMRO	10	fa	11S	20	4	O	mulberry
Swanson	AMRO	22	fa	14S	23	3	O	mulberry
Swanson	AMRO	6	fa	15S	18	4	O	mulberry
Swanson	AMRO	6.5	fa	16S	15	6	C	elm
Swanson	AMRO	1.5	fa	17S	12	15	C	elm
Swanson	AMRO	4	fa	18S	12	3	O	mulberry
Swanson	AMRO	7	fa	19S	6	3	C	elm
Swanson	AMRO	6.5	fa	20S	3	1.5	O	mulberry
Swanson	AMRO	20	fa	21S	18	2	O	maple
Swanson	AMRO	10.5	fa	25S	7	1	O	elm
Swanson	AMRO	13	fa	26S	9	15	O	elm
Swanson	AMRO	6	fa	32S	20	1	O	ash
Swanson	AMRO	20.5	fa	33S	26	4	C	elm
Renner	AMRO	10	fa?	AMRO6R	35	10	C	boxelder
Beard	AMRO	22	fa?	AMRO5B	9	15	O	maple
L-shape	AMRO	26	fl	AMRO2L	20	10	C	elm
Renner	AMRO	20	fl	AMRO4R	7	2.5	O	elm
Renner	AMRO	5.5	fl	AMRO5R	12	1	O	hackberry
Beard	AMRO	32	fl	AMRO1B	12	7.5	O	apple
Beard	AMRO	25	fl	AMRO2B	8	15	O	pine
Beard	AMRO	30.5	fl	AMRO4B	25	10	O	elm
Beard	AMRO	34	fl	AMRO6B	20	5	O	hackberry
Beard	AMRO	13	fl	AMRO9B	4	10	O	elm
Beard	AMRO	22	fl	AMRO21B	15	6	O	elm
Beard	AMRO	16.5	fl	AMRO24B	10	2	O	elm
Beard	AMRO	1	fl	AMRO25B	10	2	O	ash

Swanson	AMRO	26	fl	9S	15	12	C	elm
Swanson	AMRO	23	fl	12S	9	15	C	boxelder
Swanson	AMRO	29	fl	13S	10	2	C	elm
Swanson	AMRO	22	fl	22S	15	50	C	elm
Swanson	AMRO	24	fl	23S	15	1	O	elm
Swanson	AMRO	26.5	fl	27S	25	2	O	mulberry
Swanson	AMRO	26.5	fl	28S	18	2	C	elm
Swanson	AMRO	26.5	fl	29S	15	8	C	elm
Swanson	AMRO	27	fl	30S	8	2	O	elm
Swanson	AMRO	24.5	fl	31S	15	1	O	hnysukle
L-shape	AMRO	30	fl?	AMRO3L	15	1	O	elm
Renner	AMRO	11	fl?	AMRO7R	7	3	O	boxelder
Beard	AMRO	8	fl?	AMRO3B	28	20	O	ash
Beard	AMRO	22	fl?	AMRO10B	30	2	O	elm
Beard	AMRO	22	fl?	AMRO12B	10	20	O	pine
Beard	AMRO	1	fl?	AMRO15B	10	15	S	lilac
Beard	AMRO	8	fl?	AMRO16B	6	15	O	pine
Beard	AMRO	19	fl?	AMRO23B	28	5	O	NR
Beard	AMRO	8	fl?	AMRO26B	20	20	O	elm
Swanson	AMRO	26	fl?	AMRO1S	25	2	O	ash
Beard	BAOR	9.5	fa	BAOR3B	25	20	O	elm
Renner	BAOR	30.5	fl	BAOR1R	10	4	C	elm
Beard	BAOR	34	fl	BAOR2B	18	15	O	cottonwd
Beard	BAOR	30.5	fl	BAOR4B	25	1	O	cottonwd
Swanson	BAOR	31	fl	BAOR3S	35	6	C	cottonwd
Renner	BAOR	14	fl?	BAOR1R	20	3	O	elm
Renner	BAOR	2	fl?	BAOR1R	40	5.5	C	ash
Beard	BAOR	22	fl?	BAOR1B	35	25	O	elm
Swanson	BAOR	34	fl?	BAOR1S	35	8	C	elm
Swanson	BAOR	31	fl?	BAOR2S	20	8	C	elm
Beard	CHSP	11	fa	CHSP1B	12	10	O	pine
Beard	CHSP	6	fa	CHSP2B	2	25	O	shrub
Beard	CHSP	6	fa	CHSP3B	8	10	O	pine
Beard	CHSP	6.5	fa	CHSP4B	5	2	O	pine
Beard	CHSP	9.5	fa	CHSP5B	6	1	O	pine
Beard	CHSP	9	fa	CHSP6B	8	25	O	apple
L-shape	COGR	27	fl	COGR1L	35	3	O	elm
Swanson	COGR	21.5	fl	COGR1S	15	25	C	elm
Swanson	COGR	18.5	fl	COGR2S	20	10	C	elm
Swanson	COYE	6	fa	COYE1S	0.5	25	O	grass
L-shape	EAKI	10	fa	EAKI1L	35	10	C	elm
Swanson	EAKI	27.5	fa	EAKI1S	25	4	O	mulberry
Swanson	EAKI	14.5	fa	2S	35	8	C	elm
Swanson	EAKI	11.5	fa	4S	40	55	C	elm
Beard	EAKI	25	fa?	EAKI2B	40	30	O	elm
L-shape	EAKI	33	fl	EAKI2L	15	1	O	spruce
L-shape	EAKI	31	fl	EAKI3L	40	3	C	ash
Renner	EAKI	23.5	fl	EAKI1R	20	1	O	elm
Beard	EAKI	34.5	fl	EAKI4B	30	10	O	elm
Swanson	EAKI	42.5	fl	EAKI3S	30	20	C	elm
Beard	EAKI	29	fl?	EAKI1B	30	10	O	walnut

Beard	EAKI	15	fl?	EAKI3B	25	4	O	apple
L-shape	GRCA	11	fa	GRCA1L	3	2	S	shrub
Beard	GRCA	1.5	fa	GRCA1B	4	20	O	apple
Swanson	GRCA	3	fa	GRCA1S	15	4	O	elm
Swanson	GRCA	9	fa	GRCA2S	4	2	O	forsythia
Swanson	GRCA	23.5	fl	GRCA3S	5	12	S	mulberry
Swanson	GRCA	13.5	fl	4S	4	15	S	elm
Swanson	GRCA	1.5	fl	5S	4	3	S	elm
Beard	GRCA	29	fl?	GRCA2B	6	3	O	lilac
Swanson	OROR	13.5	fa	OROR5S	12	2	O	walnut
Swanson	OROR	9.5	fa	9S	10	1	O	elm
Beard	OROR	17	fl	OROR3B	25	15	O	walnut
Swanson	OROR	24	fl	4S	9	1	O	walnut
Swanson	OROR	26	fl	6S	20	1	O	elm
Swanson	OROR	19	fl	7S	25	1	O	elm
Renner	OROR	1.5	fl?	OROR1R	30	4	O	elm
Beard	OROR	36	fl?	OROR1B	25	20	O	elm
Beard	OROR	25	fl?	OROR2B	18	2	O	apple
Swanson	OROR	34	fl?	OROR3S	35	6	C	elm
Swanson	OROR	14	fl?	8S	25	3	C	walnut
Swanson	RBGR	6	fa	RBGR1S	12	50	C	mulberry
Swanson	RBGR	7	fa	2S	23	3	C	elm
Beard	RBGR	19.5	fl	RBGR2B	25	4	O	elm
Beard	RBGR	29	fl?	RBGR1B	20	15	O	elm
Swanson	WAVI	34.5	fl	WAVI1S	27	2	C	elm
		2046						

Appendix 1 - Point count data for all species detected (2000-2002) for corridors and woodlots. Data include Total Observations, Density (birds km⁻²) and Relative Abundance (birds/point). Species codes are the 4-letter BBL codes.

Big Sioux River Corridor

Species	Total Obs	DENSITY	RA
ALFL	4	2.40	0.02
AMCR	65	0.00	0.31
AMGO	112	98.52	0.53
AMRE	71	112.94	0.33
AMRO	85	88.91	0.40
BAOR	52	50.46	0.25
BBCU	10	0.00	0.05
BCCH	151	168.21	0.71
BEKI	2	4.81	0.01
BGGN	12	24.03	0.06
BHCO	44	26.43	0.21
BLJA	192	122.55	0.91
BRNS	3	0.00	0.01
BRTH	22	16.82	0.10
CEDW	48	60.07	0.23
CHSP	6	4.81	0.03
COGR	9	9.61	0.04
COHA	4	7.21	0.02
COYE	66	31.24	0.31
DOWO	65	52.86	0.31
EAKI	26	16.82	0.12
EAPH	5	2.40	0.02
EATO	128	98.52	0.60
EAWP	98	45.66	0.46
EUST	10	7.21	0.05
FISP	90	38.45	0.42
GCFL	15	7.21	0.07
GHOW	1	2.40	0.00
GRCA	145	216.27	0.68
HAWO	12	7.21	0.06
HOWR	363	458.96	1.71
INBU	70	50.46	0.33
KEWA	1	0.00	0.00
LEFL	2	0.00	0.01
MODO	114	28.84	0.54
NOBO	2	0.00	0.01
NOCA	91	48.06	0.43
NOFL	22	12.01	0.10
OROR	1	0.00	0.00
OSFL	1	0.00	0.00
OVEN	34	26.43	0.16
OVEN	1	2.40	0.00
RBGR	130	158.59	0.61
RBWO	38	9.61	0.18
REVI	23	28.84	0.11
RHWO	25	12.01	0.12
RNPH	5	0.00	0.02
RTHA	2	0.00	0.01
RTHU	3	7.21	0.01
RWBL	1	0.00	0.00
SCTA	11	12.01	0.05
SOSP	15	12.01	0.07
TRFL	1	2.40	0.00
TUVU	3	0.00	0.01
UNWO	2	0.00	0.01
WAVI	35	33.64	0.17
WBNU	107	79.30	0.50
WHIP	1	2.40	0.00
WITU	36	9.61	0.17
WODU	5	0.00	0.02
WOTH	71	19.22	0.33
YBCU	25	7.21	0.12
YBSA	3	0.00	0.01
YTVI	1	0.00	0.00
YWAR	69	103.33	0.33
Totals	2867	2448.60	13.52

Missouri River Corridor

Species	Total Obs	DENSITY	RA
ALFL	6	7.64	0.03
AMCR	88	12.74	0.44
AMGO	113	129.90	0.57
AMRE	37	58.58	0.19
AMRO	41	56.04	0.21
BAEA	2	2.55	0.01
BAOR	127	175.75	0.64
BBCU	11	5.09	0.06
BCCH	95	129.90	0.48
BEVI	34	56.04	0.17
BHCO	67	71.32	0.34
BLJA	137	86.60	0.69
BRTH	27	43.30	0.14
CEDW	52	91.70	0.26
CHSW	1	0.00	0.01
COGR	62	101.88	0.31
COYE	22	5.09	0.11
DOWO	46	40.75	0.23
EABL	6	2.55	0.03
EAKI	162	147.73	0.81
EATO	61	73.87	0.31
EAWP	143	127.36	0.72
FISP	58	43.30	0.29
GCFL	8	0.00	0.04
GRCA	13	10.19	0.07
GRCA	115	224.15	0.58
HAWO	9	10.19	0.05
HOWR	305	427.92	1.53
INBU	46	40.75	0.23
LASP	2	2.55	0.01
LEFL	5	12.74	0.03
MODO	162	76.41	0.81
NOCA	63	53.49	0.32
NOFL	52	28.02	0.26
OROR	47	81.51	0.24
OVEN	2	2.55	0.01
PRWA	1	2.55	0.01
RBGR	102	137.54	0.51
RBWO	33	25.47	0.17
REVI	47	66.23	0.24
RHWO	88	73.87	0.44
RNPH	3	0.00	0.02
RTHU	1	2.55	0.01
RWBL	2	2.55	0.01
SCTA	1	0.00	0.01
SOSP	10	10.19	0.05
TEWA	3	2.55	0.02
TRFL	1	0.00	0.01
TUVU	3	2.55	0.02
UNWO	3	0.00	0.02
WAVI	170	208.86	0.85
WBNU	67	58.58	0.34
WIFL	4	2.55	0.02
WOTH	80	25.47	0.40
YBCU	41	28.02	0.21
YTVI	7	10.19	0.04
YWAR	107	201.22	0.54
Totals	3001	3301.07	15.01

Woodlots

Species	Total Obs	DENSITY	RA
ALFL	3	6.79	0.02
AMCR	32	13.58	0.21
AMGO	40	64.53	0.27
AMRO	235	468.67	1.57
BAOR	85	159.62	0.57
BBCU	5	6.79	0.03
BCCH	64	88.30	0.43
BHCO	37	47.55	0.25
BLGR	1	0.00	0.01
BLJA	111	159.62	0.74
BRNS	1	0.00	0.01
BRTH	29	64.53	0.19
CEDW	15	20.38	0.10
CHSP	20	40.75	0.13
COGR	88	149.43	0.59
COYE	52	27.17	0.35
DICK	1	0.00	0.01
DOWO	36	78.11	0.24
EAKI	106	176.60	0.71
EAWP	5	6.79	0.03
EUST	50	64.53	0.33
FISP	12	3.40	0.08
GRCA	51	105.28	0.34
HAWO	2	3.40	0.01
HOSP	71	98.49	0.47
HOWR	354	777.72	2.36
INBU	33	33.96	0.22
LASP	1	0.00	0.01
LEFL	1	0.00	0.01
MODO	115	125.66	0.77
NOCA	6	3.40	0.04
NOFL	49	71.32	0.33
OROR	19	16.98	0.13
RBGR	45	81.51	0.30
RBWO	8	16.98	0.05
RHWO	105	169.81	0.70
RNPH	9	0.00	0.06
RTHA	1	0.00	0.01
RWBL	23	16.98	0.15
SOSP	50	27.17	0.33
TEWA	1	3.40	0.01
VESP	4	0.00	0.03
WAVI	14	33.96	0.09
WBNU	9	10.19	0.06
WIFL	1	3.40	0.01
WOTH	1	0.00	0.01
YBCU	10	16.98	0.07
YWAR	10	13.58	0.07
Totals	2021	3277.30	13.47

Appendix 2 - 2002 Corridor Raw Nest Data. Columns are the specific study site, bird species, exposure days for the nest, nest result (failed, fledged, or uncertain?), nest number, nest height, distance to habitat edge, vegetation category (C - closed canopy, O - open woodland, S - shrub), and the tree species in which the nest was found.								
Site	Species	Exposure	Result	Nest #	Height (ft)	Edge (m)	Veg Cat	Tree
Airport	AMRO	10	fa	AMRO1A	18	15	C	elm
Airport	AMRO	12	fa	2A	60	10	C	cottonwd
Airport	AMRO	3	fa	4A	50	4	C	elm
Union	AMRO	14	fa	AMRO1U	3.5	1	O	juniper
Union	AMRO	1.5	fa	2U	60	15	C	cottonwd
Clay	AMRO	1.5	fa	AMRO1C	6.5	5.5	C	dogwood
Clay	AMRO	3	fa	2C	50	75	C/O	cottonwd
Clay	AMRO	1.5	fa	6C	70	75	C/O	cottonwd
Clay	AMRO	6.5	fa	10C	20	75	C/O	cottonwd
Union	AMRO	13.5	fa?	4U	30	9	C	cottonwd
Clay	AMRO	1.5	fa?	5C	30	75	C/O	cottonwd
Clay	AMRO	6	fa?	7C	90	75	C/O	cottonwd
Union	AMRO	31	fl	3U	5	2	O	juniper
Clay	AMRO	20	fl	3C	7	75	C/O	juniper
Clay	AMRO	5.5	fl	4C	5	2	O	juniper
Clay	AMRO	17	fl	9C	55	2	O	cottonwd
Airport	AMRO	26	fl?	3A	40	5	C	elm
Clay	AMRO	19	fl?	8C	35	3	O	cottonwd
Airport	BAOR	4	fa	1A	60	7	O	cottonwd
Airport	BAOR	3	fa?	3A	28	15	C	cottonwd
Airport	BAOR	10	fa?	4A	25	20	O	cottonwd
Clay	BAOR	18	fa?	BAOR1C	30	10	C	cottonwd
Clay	BAOR	6.5	fa?	3C	33	10	C	cottonwd
Union	BAOR	10	fl	2U	75	7	O	cottonwd
Clay	BAOR	3	fl	6C	25	15	C	cottonwd
Airport	BAOR	28	fl?	BAOR2A	90	10	C	cottonwd
Airport	BAOR	5	fl?	5A	30	20	C	elm
Airport	BAOR	8	fl?	6A	60	40	O	cottonwd
Union	BAOR	11	fl?	BAOR1U	40	10	O	elm
Clay	BAOR	32	fl?	2C	35	30	C	cottonwd
Clay	BAOR	22	fl?	4C	80	1	C	cottonwd
Clay	BAOR	19	fl?	5C	28	20	C	cottonwd
Clay	BAOR	8	fl?	7C	40	15	C	cottonwd
Union	BRTTH	6	fa	BRTTH1U	7	10	S	plum
Union	BRTTH	6	fa	2U	4	1	O	juniper
Clay	BRTTH	6	fa	BRTTH1C	3.5	75	C	dogwood
Clay	BRTTH	1.5	fa	3C	0	1	O	post
Clay	BRTTH	13	fa	5C	5	5	C	dogwood
Clay	BRTTH	23.5	fa	2C	5.5	2	C	rusolive
Clay	BRTTH	21	fl	4C	0	4	C	dogwood
Clay	BRTTH	20	fl	6C	7	40	C	chokechry
Airport	BRTTH	20.5	fl?	BRTTH1A	6	40	O	cottonwd
Airport	CHSP	1.5	fa	CHSP1A	0.5	0	O	shrub
Clay	CHSP	1.5	fa	CHSP1C	2	1	C/O	juniper

Clay	CHSP	13	fl	2C	6	1.5	C/O	juniper
Clay	COGR	15	fa	6C	7	2	C	dogwood
Clay	COGR	25	fl	5C	10	4	C	prickash
Clay	COGR	7	fl?	COGR1C	20	2	O	rusolive
Clay	COGR	21	fl?	2C	30	4	O	ash
Clay	COGR	26	fl?	3C	40	14	O	cottonwd
Clay	COGR	25	fl?	4C	20	2	O	rusolive
Clay	COGR	22	fl?	7C	25	2	O	rusolive
Union	EAKI	41.5	fa	EAKI1U	10	1	O	juniper
Clay	EAKI	20	fa	4C	18	5	C	mulberry
Clay	EAKI	10	fa	5C	70	5	C	cottonwd
Clay	EAKI	17	fa?	EAKI1C	50	10	C	cottonwd
Airport	EAKI	20.5	fl	EAKI2A	50	4	O	cottonwd
Airport	EAKI	16.5	fl	3A	70	4	C	cottonwd
Airport	EAKI	12	fl	5A	35	3	O	cottonwd
Union	EAKI	10	fl	2U	15	0.5	O	elm
Clay	EAKI	39.5	fl	2C	55	10	C	cottonwd
Clay	EAKI	6	fl	6C	70	75	C	cottonwd
Airport	EAKI	8	fl?	4A	100	30	C	cottonwd
Union	EAPH	1	fa	2U	5	1	O	bridge
Union	EAPH	18	fl	EAPU1U	5	1	O	bridge
Clay	EATO	6	fa	EATO1C	0	0	O	juniper
Clay	EATO	20	fl	2C	0	30	C	dogwood
Clay	EATO	12	fl?	3C	0	0	O	herb
Union	EAWP	36.5	fl	2U	20	25	C	elm
Clay	EAWP	27.5	fl	EAWP1C	40	75	C	cottonwd
Clay	EAWP	6.5	fl	2C	60	75	C	cottonwd
Clay	EAWP	6	fl	3C	50	75	C	cottonwd
Union	EAWP	36	fl?	EAWP1U	30	2	C	boxelder
Union	FISP	1.5	fa	FISP1U	0	1	S	plum
Union	FISP	10.5	fa	2U	0	0	O	grass
Union	FISP	13.5	fa	3U	2	0	O	plum
Union	GRCA	9	fa	GRCA1U	2.5	5	S	plum
Union	GRCA	23.5	fl	2U	10	25	C	elm
Clay	GRCA	20	fl	GRCA1C	4	1	C/O	juniper
Clay	GRCA	27.5	fl	2C	3	20	C	dogwood
Clay	GRCA	16.5	fl	3C	3	4	C	dogwood
Airport	NOCA	3	fa	NOCA1A	3	3	S	juniper
Union	NOCA	25.5	fl	NOCA1U	3	4	S	plum
Clay	OROR	3	fa	OROR1C	50	15	C	cottonwd
Clay	OROR	10	fa	6C	12	30	C	dogwood
Clay	OROR	12	fa?	3C	25	20	C	elm
Clay	OROR	29	fl	2C	30	4	O	cottonwd
Clay	OROR	31	fl	4C	12	12	C	boxelder
Clay	OROR	20	fl	5C	15	25	O	snag/grape
Airport	OROR	22	fl?	OROR1A	50	20	O	cottonwd
Union	OROR	32	fl?	OROR1U	30	6	C	elm
Union	RBGR	6	fa	RBGR3U	8	7	O	boxelder
Union	RBGR	1.5	fa	4U	12	2	O	elm

Union	RBGR	1.5	fa	7U	6	2	O	shrub
Clay	RBGR	1.5	fa	RBGR1Ca	5	7	O	juniper
Clay	RBGR	13	fa	1Cb	5	7	O	juniper
Clay	RBGR	6.5	fa	5C	15	20	C	elm
Union	RBGR	17	fl	8U	20	35	C	elm
Union	RBGR	27	fl	5U	6	3	C	elm
Clay	RBGR	25	fl	3C	5	4	C	dogwood
Airport	RBGR	19	fl?	RBGR2A	30	50	C	elm
Union	RBGR	25	fl?	1U	8	10	C	boxelder
Union	RBGR	30	fl?	6U	25	30	C	elm
Clay	RBGR	20	fl?	2C	12	75	C	elm
Clay	RBGR	19	fl?	4C	12	15	C	elm
Clay	WAVI	6	fa	WAVI1C	45	75	C	cottonwd
Clay	WAVI	32	fl?	2C	70	75	C/O	cottonwd
Airport	WOTH	3	fa	WOTH1A	3.5	25	C	hackberry
Union	YBCU	14	fl?	YBCU1U	25	3	O	ash
Clay	YWAR	17	fa	2C	10	20	C	dogwood
Clay	YWAR	22	fl	YWAR1C	8	1	C	dogwood
		1640.5						